CLAIMS

What is claimed is:

1. A method for controlling movement of a load carrier that is pivotally attached to a boom which is pivotally mounted on a chassis, wherein a linear load carrier hydraulic actuator produces movement of the load carrier with respect to the boom and a linear lift hydraulic actuator produces movement of the boom with respect to the chassis, the method comprises:

receiving a boom velocity command designating a desired linear velocity for the lift hydraulic actuator;

sensing a position of the lift hydraulic actuator;

sensing a position of the load carrier hydraulic actuator;

deriving a setpoint position for the load carrier in response to the position of the lift hydraulic actuator and the position of the load carrier hydraulic actuator;

producing an error value in response to deviation of an actual load carrier position from the setpoint position;

producing a load carrier velocity command based on the boom velocity command and the position of the lift hydraulic actuator; and

employing the load carrier velocity command and the error value to generate an adjusted load carrier velocity command; and

operating the load carrier hydraulic actuator in response to the adjusted load carrier velocity command.

2. The method as recited in claim 1 further comprising:

determining a velocity of the load carrier;

generating a velocity error in response to deviation of the velocity of the load carrier from a desired velocity; and

wherein producing the error value also is in response to the velocity error.

3. The method as recited in claim 2 further comprising applying a proportional gain to the velocity error value prior to producing the error value.

4. The method as recited in claim 1 further comprising:

deriving a load carrier velocity from the position of the load carrier hydraulic actuator;

determining deviation of the velocity of the load carrier from the adjusted load carrier velocity command to produce a velocity error; and

wherein producing the error value also is in response to the velocity error.

5. The method as recited in claim 1 wherein producing the load carrier velocity command comprises:

converting the boom velocity command into a desired angular velocity for the load carrier; and

converting the desired angular velocity for the load carrier into a desired linear velocity for the load carrier hydraulic actuator, which desired linear velocity is used as the load carrier velocity command.

6. The method as recited in claim 1 wherein producing the load carrier velocity command comprises:

converting the boom velocity command into an angular boom velocity command;

converting the angular boom velocity command into an angular load carrier velocity command;

converting the angular load carrier velocity command into an linear load carrier velocity command; and

applying a scaling gain to the linear load carrier velocity command to produce the load carrier velocity command.

7. The method as recited in claim 1 further comprising limiting the error value to a predetermined range of values.

8. The method as recited in claim 1 further comprising setting the error value to zero when the error value is within a predefined range of values.

9. The method as recited in claim 1 further comprising receiving a load carrier velocity command; and wherein deriving a setpoint position is performed only when the a load carrier velocity command designates substantially zero velocity.

10. A method for controlling movement of a load carrier that is pivotally mounted on a boom which is pivotally mounted on a chassis, a linear load carrier hydraulic actuator produces movement of the load carrier with respect to the boom and a linear lift hydraulic actuator produces movement of the boom with respect to the chassis, the method comprises:

receiving a boom velocity command which designates a desired linear velocity for the lift hydraulic actuator;

sensing a position of the lift hydraulic actuator;

sensing a position of the load carrier hydraulic actuator;

deriving a load carrier angular position from the position of the lift hydraulic actuator and the position of the load carrier hydraulic actuator;

defining a setpoint angular position for the load carrier in response to the load carrier angular position;

converting the setpoint angular position into a linear setpoint position for the load carrier;

determining a first deviation of the position of the load carrier hydraulic actuator from the linear setpoint position

producing an error value in response to the first deviation;

converting the boom velocity command into an angular boom velocity command;

producing a load carrier velocity command from the angular boom velocity command; and

generating an adjusted load carrier velocity command from the load carrier velocity command and the error value; and

operating the load carrier hydraulic actuator in response to the adjusted load carrier velocity command.

11. The method as recited in claim 10 further comprising:

determining a velocity of the load carrier;

generating a velocity error in response to deviation of the velocity of the load carrier from a desired velocity; and

wherein producing the error value also is in response to the velocity error.

12. The method recited in claim 11 further comprising applying a proportional gain to the velocity error prior to producing the error value.

13. The method as recited in claim 10 further comprising:

deriving a load carrier velocity in response to change of the position of the load carrier hydraulic actuator;

determining deviation of the velocity of the load carrier from the adjusted load carrier velocity command to produce a velocity error; and

wherein producing the error value also is in response to the velocity error.

14. The method as recited in claim 10 wherein producing the load carrier velocity command comprises:

converting the angular boom velocity command into an angular load carrier velocity command;

converting the angular load carrier velocity command into an linear load carrier velocity command; and

applying a scaling gain to the linear load carrier velocity command to produce the load carrier velocity command.

15. The method as recited in claim 10 further comprising limiting the error value to a predetermined range of values.

16. The method as recited in claim 10 further comprising setting the error value to zero when the error value is within a predefined range of values

17. The method as recited in claim 10 further comprising receiving a load carrier velocity command; and wherein deriving a setpoint position is performed only when the a load carrier velocity command designates substantially a zero velocity.

18. A method for controlling movement of a load carrier pivotally mounted on a boom that is pivotally mounted on a chassis, a linear load carrier hydraulic actuator produces movement of the load carrier with respect to the boom and a linear lift hydraulic actuator produces movement of the boom with respect to the chassis, the method comprises:

receiving a boom velocity command which designates a desired linear velocity for the lift hydraulic actuator;

sensing a position of the lift hydraulic actuator;

sensing a position of the load carrier hydraulic actuator;

deriving a load carrier angular position from the position of the lift hydraulic actuator and the position of the load carrier hydraulic actuator;

producing a load carrier velocity command by:

(a) converting the boom velocity command into an angular boom velocity command,

(b) converting the angular boom velocity command into an angular load carrier velocity command, and

(c) generating the load carrier velocity command by converting the angular load carrier velocity command into a linear velocity;

producing a position error by:

(d) determining a setpoint angular position for the load carrier from the load carrier angular position,

(e) converting the setpoint angular position into a linear setpoint position, and

(f) generating the position error in response to deviation of the position of the load carrier hydraulic actuator from the linear setpoint position;

producing a velocity error by:

(g) deriving a load carrier velocity in response to change of the position of the load carrier hydraulic actuator, and

(h) generating the velocity error in response to deviation of the velocity of the load carrier from the adjusted load carrier velocity command;

summing the position error and the velocity error to produce a Total Error value;

generating an adjusted load carrier velocity command in response to the load carrier velocity command and the Total Error value; and

operating the load carrier hydraulic actuator in response to the adjusted load carrier velocity command.

19. The method as recited in claim 18 further comprising limiting the error value to a predetermined range of values.

20. The method as recited in claim 18 further comprising setting the error value to zero when the error value is within a predefined range of values.